Routing Protocols for MANET, VANET and AANET: A Survey

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Abstract-- **Wireless and mobile communications have become dominant of all the communication with time. An ad hoc network is a collection of dynamic wireless mobile nodes which forms a temporary network without any fixed infrastructure. Ad Hoc Networks are multi - hop wireless networks. The node uses intermediate nodes to send packet to remote nodes. For this purpose different distributed routing protocols are required. This paper presents various routing protocols specifically designed for ad hoc routing networks like MANET, VANET, AANET.**

Keywords-- **Ad Hoc Networks, MANET, VANET, AANET, Nodes.**

INTRODUCTION

Wireless networks emerged in 1970's and since then it has become popular in computer industry. In wireless network [1], networks are formed when they are required usually for short duration only. Wireless ad hoc network comprises of wireless mobile nodes which dynamically forms network (when required) without use of any fixed infrastructure. Wireless ad hoc networks are classified according to their utilization, communication, deployment and mission objectives. In this paper we will study various routing protocols for MANET, VANET and AANET. A mobile ad hoc network (MANET) [2] is an autonomous system of mobile hosts connected by wireless links. Each individual node in the network acts as a router and forwards data packets for other nodes also. Vehicular Ad hoc Network (VANET) is a special kind of MANET that is formed between moving vehicles on an as-needed basis. VANET is an emerging technology, which enables a wide range of applications like road safety, passenger convenience, and intelligent transportation etc. AANET is another form of MANET, and there are many common design considerations for MANET and AANET. In addition to this, AANET can also be classified as a subset of VANET, which is also a subgroup of MANET. The aim of this paper is to acquiring the detailed understanding of types of ad hoc routing protocols in MANET, VANET and AANET.

WIRELESS AD HOC NETWORK CLASSIFICATION AND THEIR ROUTING PROTOCOLS:

A. MANET

A mobile Ad-hoc network (MANET) is collection of mobile nodes which self-configure them to create dynamic topology. These nodes act both as router and a host which can instantaneously form networks. Nodes may freely enter or leave the network at any instant of time. The nodes which can directly communicate with each other using the radios are said to be connected nodes. Some nodes may be present within the communication range they act as intermediate nodes which passes the required information via series of local hops which ensures the connectivity between the mobile nodes which are present outside the direct coverage area of the base station. Whereas if the distance between the nodes is beyond the communication range of their own then they cannot communicate with each other. MANET allows intermediate parties to relay data transmissions. MANET is classified into: single hop network and multi-hop network. In single hop network the nodes within the same radio range directly communicate with each other. In multi-hop network intermediate node is required to transmit information if the destination node is out of its radio range. Due to its minimal configuration and quick deployment MANET is usually used in emergency situations when infrastructure is unavailable or unworkable to install like in case of natural disaster or military emergencies.

MANET ROUTING PROTOCOL: OVERVIEW

The problem with ad-hoc networking is to send a message from one node to another node without any direct link. The nodes in the network are moving around unpredictably, and it is very difficult for those nodes to communicate that are not directly linked together. There are two main methods for routing process in ad hoc networks [3]. The first method is a proactive approach [4] which is table driven and uses periodic protocols i.e. all nodes have tables with

routing information are updated at regular intervals. The second method is reactive, source-initiated or on demand i.e. every time a message is sent it first search a path by searching the entire network.

DSDV (Destination - Sequenced Distance Vector):

It is a type of proactive routing protocol based on Bellman- Ford routing algorithm. Each mobile node maintains a routing table in which all the possible destinations and the number of hops to them in the network are stored. Every entry has a sequence number. If a new entry is obtained, and then protocol selects the entry which has largest sequence number. If their sequence number is the same, then protocol selects the metric with the lowest value. Routing information is transmitted by broadcast. If any significant topology change is available then it has to be transmitted periodically or immediately. Packets are transmitted using routing tables between the different stations of the network. Each routing table provides lists of all existing destinations nodes, and number of hops to each node.

AODV (Ad-Hoc On Demand Distance Vector Routing):

It is a reactive protocol based upon the distance vector algorithm. It enables multi hop routing between the mobile nodes which want to establish and maintain an ad-hoc network. The algorithm uses different messages to discover and maintain links. Whenever a node wants to find a route from one node to another node it broadcasts a Route Request (RREQ) to all its neighbors then this request propagates through the network until it reaches the destination or to a new route to the destination.

DSR (Dynamic Source Routing):

It is a type of reactive protocols. It dynamically discovers a route across multiple network hops to any destination. In source routing each packet carries the complete ordered list of nodes through which the packet must pass. DSR doesn't use periodic routing of messages and it saves battery power, reduces network bandwidth overhead, and avoiding large routing updates throughout the ad-hoc network.

B. VANET

Another type of mobile ad hoc networks is vehicular ad hoc networks (VANETs). It is essential tool for driver of vehicle which helps him to decide finest path on the way, provide him the traffic conditions and also alert him for collision warnings. VANET network is formed to connect the vehicles and nearby fixed equipment to provide communication among them. These vehicles act as mobile nodes and they have capability of self-organizing themselves to form a highly dynamic network called VANET. Because of its dynamic nature nodes mobility is very high. Therefore it is very challenging to find and maintain route in such network. Since standard networking protocols cannot be used for VANETs many different protocols have been proposed.

VANET ROUTING PROTOCOL: OVERVIEW

VANET protocol can be classified into five categories: ad hoc routing, cluster based routing, Geographic Source Routing [5], position based routing [6] and broadcast routing [7]

Ad Hoc Routing:

MANET and VANET have many similarities they both don't rely on any fixed infrastructure while communicating. In both case nodes have capabilities of self management and self organization with short transmission range and low bandwidth. Thus, most MANET protocols such as Dynamic source routing (DSR) [8], Ad hoc on demand distance vector routing (AODV) [9] are applicable to VANET also. They were designed for general purpose MANET, routes are established when they are needed. Hence, in case of small number of network flows it reduces overhead.

Cluster-Based Routing:

Here clustering of nodes form virtual network framework in order to provide scalability. Each cluster can consist of cluster head, which is responsible for inter- and intra-cluster coordination in the network management operations. Nodes present in a cluster communicate via direct links. Cluster heads are involved in inter-cluster communication. The creation of a virtual network framework is crucial for the scalability of routing protocols, media access protocols and the security infrastructure. Cluster-based technique has also been used in information propagation and data insemination for VANETs. Cluster-based routing protocols can help to achieve good scalability for large area networks, but a significant stumbling block for them in fast-changing network of VANET systems is the overhead and delay involved in creating and maintaining these clusters.

Geographic Source Routing:

Geographic Source Routing (GSR) uses a Reactive Location Service (RLS) to get the destination node position. The algorithm gathers knowledge of the city network which is provided by a static street map in city environment. Using this information, the sender node determines the paths that are to be traversed by the packet using Dijkstra's single source shortest path algorithm. Forwarding between different junctions is

then implemented in a position-based manner. By combining the geographic routing results and topological knowledge from city maps, GSR proposes a suitable routing strategy for VANETs in city area.

Position Based Routing:

Position based routing is based on positional information of nodes for routing. To deliver the packets source uses the positional information of the destination instead of using its network address. Geographic position System (GPS) is used by each node to determine its location and its neighboring node location. The node identifies its neighbor as a node that located inside the node's radio range. When the source wants to send a packet, the position of the destination is stored in the packet header to forward the packet to the destination this avoids the need of route maintenance, route discovery or even awareness of the network topology. Thus these protocols are considered to be more suitable for VANET with a highly dynamic network environment, compared to Dynamic Source routing protocols.

Broadcast Routing:

Broadcast routing is most frequently used routing technique in VANETs, such as sharing traffic information, weather broadcast, emergency situations, road condition during traffic, and to make announcements and deliver advertisements. Broadcast can also be used in unicast routing protocols to discover an efficient route from source to the destination. Multi hop is used when the message needs to be passed to the vehicles which are out of the transmission range. Flooding is the simplest way used to implement a broadcast technique in which each node re-broadcasts messages to all of its neighbors nodes except the one it received this message from. Flooding insures that the message should reach to all nodes in the network. Flooding doesn't perform well when there are large numbers of node in the network in such cases performance drops quickly whereas for small number of nodes flooding works relatively well and is easy to be implemented. The bandwidth requested for broadcast of message transmission can increase exponentially. As sending and receiving of message between each node occurs at the same time, this may cause collisions and high bandwidth consumption. To avoid network congestion selective forwarding may be used.

C. AANET

Ad hoc network technology plays a great role in communications between aircrafts. An aircraft ad hoc network (AANET) [10] is type of MANET in which communication occurs amongst remote aircrafts without any fixed ground infrastructure. Air ad hoc networks (AANETs) [11] provide scalable and cost-effective solutions for applications such as dynamic route planning and traffic safety using long-range wireless communication. There are various issues regarding AANETs routing protocols. These issues focuses on key routing operations like route establishment and maintenance, QoS (Quality of Service), minimize routing overhead and delays. They also provide an efficient and reliable routing scheme for AANETs. A secure routing protocol is an interesting area to work on confidentiality of inter-airline communications in future AANETs. It must preserve the reliability and accuracy of routing processes within a malicious environment.

AANET ROUTING PROTOCOL: OVERVIEW

AANET routing protocols classification is based upon network structure adopted in protocol design into two parts: topology based routing protocol which regroups reactive, proactive and hybrid routing, geographic protocols [12]: which require the assistance of a GPS (Global Positioning System) to provide the node positions. With reference to delay point of view, routing protocols should provide good performances compared to topology-based protocols since there is no need to maintain routing tables or set-up route paths before sending a packet.

GRAA(Geographic routing Protocol for Aircraft Adhoc Networks):

Here routing scheme behaves differently, depending on aircraft movements. Each aircraft hold a neighbor routing table periodically updated in order to keep track on the moving direction of its one hop neighbor. The next hop is decided using a predictive heuristic on both the expected geographical position of the destination and the node velocity.

AeroRP (Aeronautical Routing Protocol):

The routing decision is based on a speed heuristic calculated for each one-hop neighbor of the node holding the packet. This decision metric is calculated by the source node for all its neighbors in order to know which one will be the sooner in the transmission range of the destination.

GLSR (Geographic Load Sharing Routing):

It exploits path diversity to compensate congestion issues using the TDMA technique. GLSR reduces the link congestion by using multipaths and maximizes the speed of advance of all neighbors toward the destination.

CONCLUSION

In this paper we have presented different routing protocols for ad hoc networks like MANET, VANET and AANET. It can be seen in study that various routing protocols can be used, depending upon the ad hoc network utilization, communication, deployment and mission objectives. This study can be useful for the secure transmission of data from source node to the destination node in multi-hop networks.

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